

1st edition:
Version:

November 2021
Original

Design of a high speed railway - Communication and signalling



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IRS to be classified in volumes of UIC:

VI - Traction

Complete reference in case of citation:

IRS-60681:2021, Ed1: Design of a high speed railway - Communication and signalling

Approbation date:

8 December 2020

With effect from:

8 December 2020

Application recommended to:

8 December 2020

Keywords:

High speed railway; Design; Communication; Signalling

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Published by the International Union of Railways (UIC)
16 rue Jean Rey, 75015 Paris - France, November 2021
Dépôt Légal November 2021

ISBN 978-2-7461-3129-3



Record of updates:

1st edition, November 2021

Creation of the document

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Foreword

An International Railway Solution (IRS) is a document drawn up by consensus and applied on a voluntary basis which aims to facilitate and harmonise railway operation.

IRSs are gradually replacing UIC leaflets.

Members of the International Union of Railways (UIC) participate in the creation of IRSs, from which they benefit in full. Furthermore, marketing to railway stakeholders contributes to the sharing and harmonisation of good practices, in accordance with UIC's primary goal.

While IRSs do not have the force of law, they are created and published in a professional manner and with technical approval on the basis of UIC procedures, and have full technical legitimacy in the railway sector.

The "General application" section constitutes the heart of the IRS and contains the working group's expertise applicable in the broadest manner. The addition of a "Specific application" aims to cover factors specific to a region, a type of service, etc.

Some provisions shall be implemented in all cases to ensure correct application and to maintain the system's cohesiveness. Certain operational circumstances require that specific provisions be systematically applied by all users of the document.

For the purposes of understanding, the user acknowledges that the expression of:

- obligation indicates requirements to be respected in order to comply with the expertise expressed in the document (usually "shall");
- recommendation indicates options that are favourable but not essential (usually "should");
- permission indicates options that are recognised but without consequence (usually "may");
- capacity indicates possibilities from a technical standpoint and not permissions or probabilities (usually "can").

Obligation, recommendation and capacity can be expressed in the negative to indicate prohibiting, non-recommendation and incapacity.

If applicable, notably for the purposes of compliance with a UIC approval, passages that are recommended or mandatory for the cohesiveness of the system will be accompanied by the letters "R" and "MCS" respectively.

This IRS reflects the following UIC working group expertise:

High speed IRS working group - Intercity & High Speed Committee (ICHSC)

It integrates in full or in part the following UIC leaflets:

- none

It complements the following standards:

- *IRS 60672: Implementation of a high speed railway - Feasibility phase*
- *IRS 60673: Implementation of a high speed railway - Design phase*

The following IRSs constitute a complementary series:

- *IRS 60680: Design of a high speed railway - Infrastructure*
- *IRS 60681: Design of a high speed railway - Communication and signalling*
- *IRS 60682: Design of a high speed railway - Energy*
- *IRS 60683: Design of a high speed railway - Interface*

Executive summary

This IRS deals with the design of communication and signalling for high speed railways. It contains guidelines used to give a global vision of the design of high speed systems.

It contains the design of signalling and communication systems and supporting equipment and facilities.

It integrates in full or in part the following IRS:

- none

It aims to complement the following standards:

- *IRS 60672: Implementation of a high speed railway - Feasibility phase*
- *IRS 60673: Implementation of a high speed railway - Design phase*

Field of application

This IRS applies to the design of HSR (see [Abbreviations and Symbols - page 6](#)) communication and signalling.

This IRS includes the design of signalling and communication systems, supporting equipment and facilities, etc.

This IRS provides the main design concepts and requirements based on previous experience. However, considering future technological development in different countries, the main design concepts mentioned in this IRS may be adjusted according to specific circumstances.

This IRS focuses on high speed passenger networks. HSR lines (see [Abbreviations and Symbols](#)) used for freight transportation should be designed according to specific circumstances.

Reference documents

The following documents are cited in this IRS or strongly support its requirements and recommendations:

1. International Standards

International Electrotechnical Commission (IEC)

- [1] *IEC 62305-4: Protection against lightning - Part 4: Electrical and electronic systems within structures*
- [2] *IEC 62425: Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling*
- [3] *IEC TS 62773: Railway applications - Procedure to determine the performance requirements for radio systems applied to radio-based train control systems*

International Telecommunication Union (ITU)

- [4] *ITU-T G.825: The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)*
- [5] *ITU-T G.826: Error Performance Parameters and Objectives for International, Constant Bit Rate Digital Paths at or Above the Primary Rate*

Abbreviations and Symbols

AON	Active Optical Network
ATC	Automatic Train Control
BSS	Base Station Subsystem
BTS	Base Transceiver Station
CBI	Computer Based Interlocking
CTC	Centralised Traffic Control
CTCS	Chinese Train Control System
DMI	Driver Machine Interface
eMLPP	enhanced Multi-Level Precedence and Pre-emption
ETCS	European Train Control System
ETSI	European Telecommunications Standards Institute
FA	Functional Addressing
GPRS	General Packet Radio Service
GSM-R	Global System for Mobile Communications - Railway
HSR	High Speed Rail
IN	Intelligent Network
IP	Internet Protocol
IRS	International Railway Solution
ITU	International Telecommunication Union
LCX	Leaky Coaxial Cable
LDA	Location Dependent Addressing
LEU	Lineside Electronic Unit
MA	Movement Authority
MPLS	Multi-Protocol Label Switching

MS	Mobile Station
MSTP	Multi-Service Transfer Platform
NSS	Network SubSystem
ODN	Optical Distribution Network
OLT	Optical Line Terminal
ONU	Optical Network Unit
OSS	Operation Support System
OTN	Optical Transport Network
PON	Passive Optical Network
PTN	Packet Transport Network
QoS	Quality of Service
RAMS	Reliability, Availability, Maintainability and Safety
RBC	Radio Block Centre
RR	Route Reflector
SDH	Synchronous Digital Hierarchy
SPD	Surge Protection Device
SSS	Switching SubSystem
TCC	Train Control Centre
TCP/IP	Transmission Control Protocol/Internet Protocol
TSR	Temporary Speed Restriction
TSRS	Temporary Speed Restriction Server
UPS	Uninterruptible Power Supply
VPN	Virtual Private Network
VRR	VPN Route Reflector

Design of a high speed railway - Communication and signalling

General Application

1 – Introduction

This IRS (see [Abbreviations and Symbols - page 6](#)) contains guidelines used to give a global vision of the design of high speed systems. It provides the HSR (see [Abbreviations and Symbols](#)) experience of various countries, in pursuit of applicable, rational, advanced and feasible IRS (see [Abbreviations and Symbols](#)).

1.1 – Context

High speed rail (HSR - see [Abbreviations and Symbols](#)) is a safe and efficient mode of transport with high competitiveness in terms of safety, speed, capacity and sustainability, and plays an important role in the transport system.

When it comes to the construction of railways worldwide and the application of new technologies, HSR (see [Abbreviations and Symbols](#)) drives a large part of the momentum and consequently boosts the development of the railway industry.

HSR (see [Abbreviations and Symbols](#)) is a complex system that incorporates advanced technologies for infrastructure, communication and signalling, energy, and rolling stock.

The design of HSR (see [Abbreviations and Symbols](#)) is the basis for achieving the desired system functions. To guarantee safety, it shall balance technological innovation and reliability, coordinate riding comfort with economy, and reconcile high speed with short intervals.

This IRS (see [Abbreviations and Symbols](#)) applies to the design of HSR (see [Abbreviations and Symbols](#)) communication and signalling.

The design of an HSR (see [Abbreviations and Symbols](#)) signalling system should ensure the safety of train operation, improve transportation efficiency, and ensure train operation follows traffic command.

The design of an HSR (see [Abbreviations and Symbols](#)) communication system should provide a secure and reliable communication network that covers various railway service nodes to dispatch and command train operation and effectively organise transportation and management.

1.2 – Objectives

The objectives of developing the IRSs (see [Abbreviations and Symbols](#)) in the “Design of a High Speed Railway” series are to:

- Guide the construction of HSR (see [Abbreviations and Symbols](#));
- Reflect the performance of HSR (see [Abbreviations and Symbols](#)) system;
- Disseminate advanced technologies worldwide;
- Promote the sustainable development of ecology and environment.